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The Air Line Pilot

August, 1956

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DC-7C Evaluation

Common System Development --- 1956

The Author Gives His Opinion On The Outlook Of The Common System — Text Of A Speech Delivered Before Institute Of Aeronautical Sciences

By James L. Anast
Electronics Engineer, ANDB

The reorganized Air Navigation Development Board has been in existence for nearly two years. It is reasonable and fair to ask, "What is the outlook for the Common System?"

In the early part of 1956, one can only answer this question with optimism. Indeed, we are approaching an era, when giant strides must and will be made in air navigation and traffic control. There are several reasons for this:

▶ There is now an irresistible pressure from all sides on such organizations as the Air Navigation Development Board and the Civil Aeronautics Administration to deliver a system to cope with the "jet age."

In spite of the almost inextricably tangled government organization, and through "sins of the fathers," there is a slow but accelerating progress in clarifying the system toward which we are evolving, and how we are getting to it from today.

No New System Needed

▶ Fortunately, and apparently contrary to general thought on this subject from SC-31 onward, we do not need the invention of a new system. I take into account all the bright new systems which were proposed in the optimistic period from 1945 to 1950. They all have had their day and have been discarded.

As a matter of fact, we already possess a system of air navigation and traffic control. We need not tinker with the philosophies governing safety of operation. These have been built up by the CAA over years of careful cut and try processes. Nor do we need additional academic theories on ideal techniques for the control of aircraft. What we need is improvement in almost all facets of the present system. We need for example a communications system, whose longest time lag is not critical to the control loop from the ground to the aircraft and back to the ground. We need higher precision in our navigation system in order that the "vanishing airspace" is not used so extravagantly. We need to relieve human controls of routine functions wherever this can be done safely, and put them in machines, which are better than humans in relatively simple repetitive operations.

Overall Problem

▶ We in the government are finally orienting our thinking to the overall system problem, rather than the equipment problem. Traditionally, the system of air navigation and air traffic control has consisted of several carefully separated elements:

a. Regulations
b. Procedures
c. Navigation aids

Initially, the navigation aids consisted of a few pieces of equipment, a communications set, a magnetic compass, a radio homing device, etc.

The equipment, procedures, and regulations which are required now, are so intimately interrelated that consideration must be given to the entire system from the earliest stages of policy and requirement studies, budget preparation, operational analysis, planning, through the research and development phases including evaluation and service testing.

Until recently the research and development of navigation and traffic control systems has been carried out piecemeal. The "system" was then put together by the CAA, the operating organization of the NAV aids, and then welded into a working entity by the ingenuity of the operating people involved. This explains partly the traditional conservatism of the CAA to accept new equipment. The introduction of new equipment piecemeal into an operating system might cause a deteriorating effect on other elements of the system, such as safety, number of communication channels, etc.

If the *total* system is developed in an orderly manner and tested in a realistic environment, then there can be no reservations on its effect on "the rest of the system."

It should be pointed out that in air navigation and traffic control we have lagged behind in the evolution which has taken place universally throughout industry and the agencies of the Department of Defense in airframe development, weapon systems, telephone systems, etc. I am optimistic for this

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very reason, because we can draw on the successful experience of others engaged in the research and development of comparable systems.

A Working Technique

The last reason for predicting success of the present configuration of the Air Navigation Development Board is that we have a working technique for the development of the common system. This technique is based on modern system engineering, and takes into account the lack of complete system operational requirements. *(See Fig. 1.)* The ANDB has established two groups, which are key stones of the process we are using for system development:

a. The Systems Requirements Advisory Team

b. The Systems Engineering Advisory Team

Operational requirements flow from many sources, and are digested, consolidated and clarified by the requirements team. The members are drawn from experienced operational personnel from the ANDB agencies. The Systems Engineering Advisory Team, composed of ANDB agency system engineers plus scientific consultants, postulate several systems which appear to meet the requirements. I say "appear," because we do not have complete and clear enough requirements to be certain that any system we analyze is adequate.

"Monte Carlo" Simulation

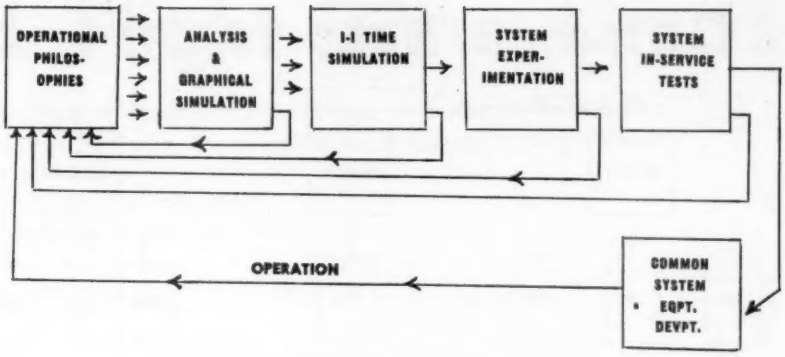
After some initial analysis, these systems will be subjected to a "Monte Carlo" simulation. The "Monte Carlo" technique is fairly idealized simulation, using graphical or mechanical techniques, wherein the forecast random traffic is fed to postulated systems. This technique has been successfully used already in air traffic control, initially by the Airborne Instruments Laboratory in 1947, and more recently and extensively by the Franklin Institute. In another field, automatic pilot development, analogue computers have been successfully used in this type of analysis for several years.

The "Monte Carlo" technique will be used to determine profitable avenues for further investigation, and "weed out" impractical systems as a feedback to the System Requirements Advisory Group, will furnish comparative "ball park" figures on capacities, delay characteristics and other critical features of the postulated systems under analysis.

It should be stated that in this stage of the process, a 1-to-1 time scale is not used. Therefore, the human responses are idealized to a great extent. That is why we go to the next step, 1-to-1 time scale simulation.

One-to-one time simulation is considerably more expensive than the "Monte Carlo" technique, and as yet we do not have the capability of inserting the large numbers of aircraft that are predicted for the future. This is now done at TDEC with Franklin Institute. We will then examine the portion of the system for which the human responses are critical, to establish the validity of the previous tests. As before, the output serves to determine the need for further, more realistic tests, and as empirical data for the Systems Requirements Advisory Team.

The next step is actual system experimentation, whose expense and risk increases by another order.



SYSTEM ENGINEERING FLOW CHART

Fig. 1

In-Service Tests

After this, and again to increase the realism of the analysis, in-service tests are carried out. At the successful completion of this phase, the ANDB can then publish system characteristics, and it can then recommend with considerable assurance the implementation of the proposed system.

The question may now be asked, "How do you get to the new system?" We have postulated the capacities required for the 1965-1975 period; the "Monte Carlo" and 1-to-1 simulator techniques permit us to start from the present system, subject it to increased traffic demands, examine analytically the critical portions of the system, and obtain data on simulated "fixes" or modifications. If the modifications do not work, we have neither delayed actual aircraft, involved expensive equipment, nor been forced to use it even though it is a blind alley. We then go through a series of modifications, checking at each stage with the Systems Requirements Advisory Team, on perhaps several promising avenues of evolution, until we find one or more solutions. *(See Fig. 2.)*

In carrying out further tests, or experimentation, or even in-service evaluation, we automatically carry with us the evolutionary steps which are necessary if the system is to be implemented.

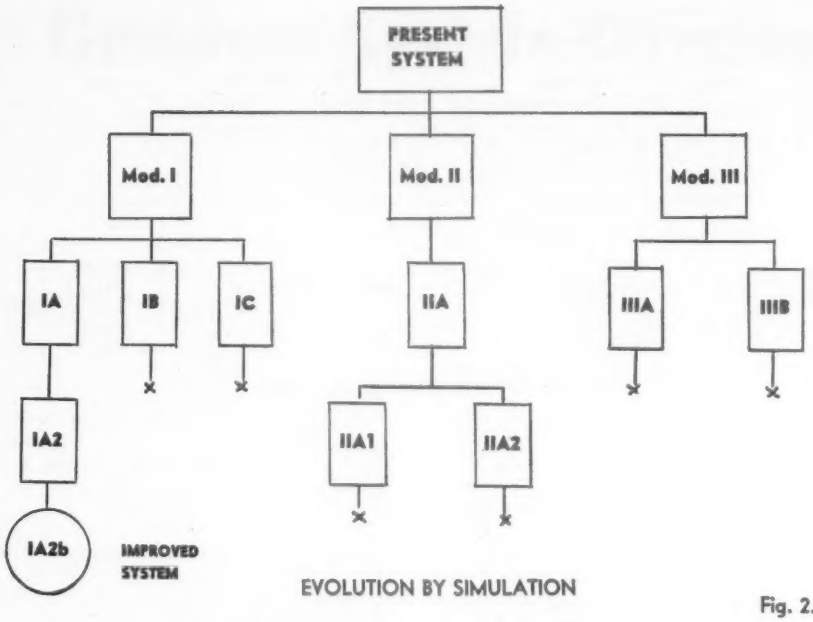
In this manner we expect to be able to answer the question, "But how do you get there from here?"

Predicts Evolution

Now, that I have exuded so much confidence, may I do some predicting for you of the character of the evolution, which we will see in the next two decades.

On The Cover

ALPA Douglas DC-7C Evaluation Committee boards DC-7C for flight demonstration, during recent evaluation, at which ALPA group met with Douglas personnel on new features of transport, prior to its introduction into line service. Shown left to right: T. Patecell, PAA; T. G. Linnert, ALPA Engineering & Air Safety Dept.; J. Martin, Douglas engineer; a Douglas flight test engineer; R. Holm, PAA; D. Castle, Douglas flight test engineer; A. Mellon, DC-8 Project engineer; R. Snorkness, NWA Chief pilot; C. Darnell, BNF; L. H. Mouden, BNF; J. Grier, EAL; B. Larson, NWA; W. Carr, Douglas Engineer test pilot; Wm. Barnard, NWA; B. Frees, NWA; D. Leonard, NWA.



EVOLUTION BY SIMULATION

Fig. 2.

Let me hasten to say that equipment may change, but our system will basically remain the same. Our system today is not homogeneous. There are several basic navigation systems all in use. There are at least two kinds of rules for separating aircraft, and of course there are as many ways of expediting aircraft as there are controlled areas in the system throughout the U. S. A.

In this conglomerate system are the solid cornerstones for future progress. Our job is to emphasize and depend more on the cornerstones, and gradually wean ourselves away from the crutches, "quick fixes," and expedients which tend to obscure the basic solidity of the system.

Radar Role

The first improvement we will see in the common system will be through the gradually increased use of radar and the radar beacon to make radar an all-weather device. This will be associated with direct communications throughout the coverage volume of the radars. I believe that the CAA will accomplish this through remoting appropriate sectors to air defense radars, and we will see an occasional long-range radar operated jointly by the military and CAA in critical areas where air defense radar does not cover. The radar safety beacon will be used by military and civil aircraft. Those civil aircraft, which will be expected to fly (even in a state of alert), will carry a beacon similar to the one under development. On the ground there will be "defruiters" associated with the interrogator, and side lobe suppression may gradually be brought in by kit modification. The itinerant civil aircraft will have a "common man's" beacon, if American ingenuity can devise one. If not, in certain areas they will continue to be handled as in today's system, except when positively identified and tracked by radar.

Sees Mutual Facilities

As the improved air defense system goes into operation, I believe that CAA and air defense facilities will be combined, through mutual agreement, after comprehensive system tests now planned for in the Boston area. The ANDB has developed a plan for a joint civil-military traffic control experimental system environment in the Boston area. This plan includes analytical studies and experiments in integration of air defense and air traffic control. The ANDB plan is complementary to the "first stage integration of ATC and air defense" plan recently proposed by the CAA at the behest of the ACC. I expect that these tests will result eventually in fairly complete physical integration of air traffic control and air defense facilities. Great savings in personnel and communication facilities will be made through this cooperation. Military and civil personnel will work together in maintaining traffic control of all aircraft. Communication equipment during transition will be diverse for different classes of civil and military aircraft, using the same integrated ground distribution system. Voice channels will continue to be used as far as can be foreseen, but will carry less and less load as automatic traffic control signalling and radar derived position data are implemented.

Traffic control in the enroute zones —where density is low, will be based on a grain size consistent with density. Separation will always be based on interlocking closed circuit techniques, utilizing a planned redundancy of communication for increased reliability.

In dense areas of operation such as terminal areas, I expect that the CAA will operate its own radars. A coarse system of separation will be in force as close as possible to the terminal area. In New York, for example, coarse control with possibility of holding may be used to approximately 20 miles, or even closer. Inside a certain volume, whatever it may be, there will be no holding. Aircraft proceeding into this volume will either make their scheduled landing or go around. Delay path computation, to regularize the landing interval will first be accomplished manually, and eventually automatically. The principle of the computer utilized for this delay path computation will be as follows:

- It will search for a nonconflicting path, with the least amount of delay.
- This path will be determinable in the air and identified with the aircraft's navigation system.
- It will be transmitted to the aircraft and modified as necessary.
- Aircraft will only proceed as long as positive instructions arrive. The aircraft receives alternative course of action for go around at each stage of the approach.
- Delay will be inserted either positively or negatively through:
  a. Path change
  b. Programming speed change timing
  c. Only when necessary, differential speed change.

Reduced To Standby Operator

The role of the human controller through the next two decades will gradually reduce to a 24-hour standby operator for a lower capacity system in case of mechanical or electrical failure.

His first automatic aid will be an ingenious mechanism, which will be a push button traffic control clearance equipment. This equipment will permit him to transmit appropriate short clearances via selection on his display. Part of this system is an interlocking arrangement, which will prevent issu-

(Continued on Page 14)

Fatigue And Flight Time Limits

Fatigue Is Still A Relatively New Concept In Aviation. A Case In Point: The Italian Air Line Crash In Which Fatigue Was Listed As A Contributing Factor

By J. A. Newton

Chief, Flight Branch of ICAO Air Navigation Bureau

At approximately 1400 hours on an overcast December day in 1954, persons in the vicinity of Idlewild Airport, New York, were startled by a violent explosion followed by the signs of an intense fire. Investigation revealed that an incoming European aircraft, a DC-6B, had crashed into the pier supporting the approach lights to Runway 4, had been demolished by the impact and had carried 26 persons to their deaths in the icy waters of Jamaica Bay. An inquiry into the accident was carried out by the Civil Aeronautics Board and their findings published. The probable cause of the accident was determined as an erratic approach, which resulted in a descent too low to avoid striking the pier, but a significant rider was added to the effect that a contributing factor was pilot fatigue due to the particular and difficult circumstances of the flight.

Causes For Fatigue

What is fatigue? What causes it, what are its results and what can be done to prevent its occurrence or to minimize its effects? Fatigue has been known in industry long before aviation became aware of its implications. It must have been a major problem in the early years of the industrial revolution when workers were forced to carry out their duties under the worst possible conditions, for the least possible pay and the longest possible time and, indeed, the first recorded recognition of fatigue in industry occurred in England with the passing of an Act of Parliament in 1802, by which the hours of work of children employed in the factories were limited and certain standards of ventilation and cleanliness were demanded of the factories that employed them. This Act has been followed through the years by numerous other labor acts put into force in many other countries and many other industries.

Industry has approached the solution of the problem in several ways. It was recognized that conditions of work and hours of duty had much to do with the onset of fatigue which manifested itself in a decrease in output, a lowering of efficiency and an increase in the number of accidents.

Long-Time Efforts

A solution was not arrived at over night; trade unions and other labor organizations have negotiated with management over a long period of time, but at present, hours of work in nearly every industry have been drastically reduced, practically to the optimum. Higher wages and other monetary benefits have removed much of the dissatisfaction of the worker and health and insurance plans do much to safeguard his future after retirement or at such time as his useful working life may be at an end. In order to keep production at a height and costs at a reasonable level, industry has needed to coordinate such social improvement with vast technical strides so that a balance may be achieved and maintained between costs and profit.

Fatigue In The Airman

But fatigue is still a relatively new concept in aviation. Studies are at present in progress on aircrew fatigue in many States throughout the world in an endeavor to answer such questions of cause and effect—but these studies have succeeded largely in pointing up the complexities of the problem. Individual studies, however, have also been undertaken by many highly-trained technical specialists which have produced much interesting data.

It is reasonably simple to define physical fatigue resulting from overexertion, but fatigue in the airman can hardly be considered to result solely from prolonged sustained activity. Many clinical studies have been undertaken in an effort to define fatigue in quantitative units but so many variables become obvious that this has proved impractical.

Sir Frederick Bartlett who has conducted many such studies, has developed a concept of skill fatigue in which he distinguished between the fatigue produced by hard physical effort and that occasioned by work demanding little in continuous muscular reactions but much in persistent concentration and a high degree of skill. He himself uses the term fatigue "to cover all those determinable changes in the expression of an activity which can be traced to the continuing exercise of that activity under its normal operational conditions, and which can be shown to lead, either immediately or after delay, to deterioration in the expression of that activity, or, more simply, to results within that activity that are not wanted."

Physiological Condition

Fatigue can, perhaps, be best described as a physiological state of tiredness, exhaustion or lassitude resulting from changes in body chemistry and physiology as a result of exertion which tends to inhibit further activity. Its onset is insidious and its victim may or may not be aware of its presence which manifests itself in a steady deterioration of skill and efficiency and cannot be dissipated by stimuli. Aircrew fatigue itself may then be divided into two stages, transient fatigue which is the normal fatigue manifest in a healthy individual following a period of exertion or excitement, and which responds to normal sleep, rest and freedom from such excitement, and cumulative fatigue which does not so respond but which may occur after transient fatigue when an individual has undergone stress of such great intensity that normal recuperation does not occur, and which may even result in a change in personality known as aeroneurosis.

Anxiety, One Of The Causes

In an attempt to discover the causes and results of fatigue in aircrew, a series of experiments were conducted in England, usually referred to as the Cambridge Cockpit Studies, in which actual flying conditions were simulated as the tests were in progress. These experiments were governed by the idea that a pilot anticipates the dangers in flying and responds to such "anticipatory tensions" (as it was named) with responses intended to remove the danger and so relax the tension. However, it was discovered that pro-

nounced anticipatory tension can be the equivalent of anxiety. It was further thought that a pilot's skill is highly organized and when disrupted tends to produce errors and it is recognized that strong emotion, e.g. anxiety, leads in certain conditions to such a disorganization of skill.

After long periods at the controls in these tests, a distinct deterioration in skill and accuracy became apparent and the subjects were willing to accept lower standards of accuracy and performance as they became more fatigued, failing to integrate the instruments as a whole while concentrating on one individually. The range of their attention diminished with a significant forgetfulness of peripheral instruments and landing-gear switches were frequently overlooked. There was a sudden increase in errors at the end of a simulated flight, indicating that a tired airman has a tendency to relax when in sight of his destination.

Numerous other studies of fatigue have been undertaken with the idea of providing preventive medicine whereby a case of simple transient fatigue can be prevented from becoming cumulative fatigue and areoneurosis. It is recognized that flying is a serious responsible occupation, requiring a high level of skill and intelligence. This high degree of intelligence often makes a pilot more conscious of his surroundings and minor discomforts. He is continually adding to his knowledge those things which he learns from each new flight and from the accidents he may witness or hear about. He may have acquired financial, social and family responsibilities and these, coupled with the responsibility he feels for his crew, his passengers and his aircraft, may begin to cause persistent, though unacknowledged, anxiety.

Such feelings of anxiety and responsibility are entirely normal so long as the individual can handle his problems constructively, but when such anxiety is unresolved, tension increases. This continuing tension may keep him awake at night so that he feels stale and irritable, his digestion may be affected and he loses the desire to fly. Excessive work without frequent rest periods tends to affect the central nervous system as well as bodily resistance and it has been found that cumulative and persistent anxiety, coupled with an inability to escape the responsibilities to which he is constantly subjected, may finally result in aeroneurosis which produces a definite change in the personality of the airman.

Other Factors

What causes fatigue in actual flight? Studies have produced many variables. The design of the aircraft itself, its size and weight, the location of instruments, the effort required to activate the controls, the noise and vibration to which the crew is subjected together with variants of altitude, pressure, temperature, noxious gases and oxygen all have an influence upon fatigue. Load—that is the number of items which have to be dealt with simultaneously or nearly simultaneously—is also a factor. Much depends too upon the duration of the flight, the frequency of landings and take-offs, the weather encountered and the amount of instrument flying undertaken as prolonged mental strain, anxiety or fear is known to result in a depleted reserve of energy.

Outside influences make themselves felt in the regions and climatic variations through which flights are made, the duration of stay in each climate, in poor airports and inadequate ground services, in travel to and from the airfields as well as such minor factors as meals at outlying stations. The amount of time spent in preflight duty as well as delays in the planned flight with their resultant uncertainties and anxieties are also significant contributors. Economic problems and personal worries relating to the pilot's home life are factors also in predisposing him to fatigue, since it is generally accepted that anxiety and emotional vexations may interfere with the judgment needed to carry out accurately timed and coordinated movements and lead to preoccupation and absentmindedness. Pilots with nervous or neurotic temperaments aggravated by domestic troubles, cannot conduct crew coordination or give the necessary confidence required, when the crew faces unusual conditions.

With all these variables and the possible different combinations thereof, States have found it impossible to provide regulations to cover all exigencies, but there is a substantial measure of uniformity in their ideas as to the ultimate limits of endurance of flight crews.

Critical Peaks During Flight

What are the results of fatigue in aircrew? Aircrew must be able to operate with maximum ability during certain peaks of activity, and it is significant that the Cambridge Studies discussed above showed that the effect of fatigue is greatest at the end of a flight when the demands for efficient performance are at their height. It is frequently necessary for the pilot to produce a reserve of energy and capacity at the end of a long flight in order to make an instrument approach, which, as in the case of the ill-fated aircraft previously mentioned, may be most difficult. The deterioration of skill and the acceptance of lowered standards noted in the Cambridge tests is particularly significant in relation to the over-looking of landing-gear switches, since misuse of landing-gear is a common cause of accidents.

The findings of courts of inquiry into several recent and spectacularly disastrous accidents have included comments on the fatigue of the crews involved, underlining the fact that errors of judgment are more likely to occur when an airman is tired. It has been pointed out that first-class vision, with particular reference to convergence and accommodation, is a primary requirement for flying personnel, and that fatigue can noticeably impair such visual acuity.

It is noteworthy that in several recent accidents where fatigue has been a contributing factor, visual errors (during landing and final approach) have been the primary errors leading to the accident. From all the evidence gathered by States and in clinical experiments, it would appear that fatigue is cumulative and leads to errors of judgment which can endanger the safety of the aircraft, its passengers and its crew. The results of fatigue are, therefore, frequently deadly.

Preventive Factors

What can be done to prevent fatigue? Obviously a great deal depends upon the individual in the aircrew. He must maintain good physical and mental health by following a program of adequate exercise; too much is as harmful as too little, and good and adequate rest. He must abstain from excessive consumption of tobacco and alcohol and follow a healthful diet, for if he neglects to balance his diet, he may, for instance, eventually suffer a lack of vitamin A which will affect his visual acuity. To compensate for such a reduction in vision during flight he will be constantly straining and the mental and bodily strain so caused will quickly tire him. He must do all he can to ensure that he approaches a flight in the best of health and well-rested. The operator for his part must do all in his power to assist his aircrew by providing good, reliable aircraft, well-maintained and serviced, together with all possible ground aids.

Dr. Russell Davis of the United Kingdom in his comments on studies of pilot error, states that: "It is reasonable to expect that if pilots come to regard flying as safe, from confidence in the conditions in which they fly, the accident rate will decline. On these grounds alone, everything possible should be done to relieve pilots of anxiety about the outcome of their flights. Traffic and other arrangements should be such that not only are the dangers reduced, but pilots should regard them as reduced. For the same reasons, careful briefing must be regarded as important."

Health Services

Adequate health services and counsel wherever possible for emotional problems to relieve anxiety and tensions will assist the operator to keep his crews at the peak of their efficiency, and it must be remembered that the time and expense of producing a highly trained airman are lost when a crew member suffers fatigue. It is recognized that operators must obtain the greatest possible utilization of expensive aircraft and that crew schedules must be integrated with the schedules of maintenance work, but much irritation and annoyance can be eliminated by the advance preparation of crew schedules and by adhering to them. Proper scheduling so that flight time is evenly divided with, as far as possible, no pilot assigned on successively long and tedious flights can do much to keep fatigue at bay. Ensuring adequate messing and other facilities at outlying stations and keeping preflight duty and stand-by time to the minimum will also help. Furthermore, it is the operator's responsibility to ensure the thoroughness of all maintenance work as a series of even minor mechanical difficulties can cause anxiety and uncertainty over the serviceability of the aircraft.

Since the present human design appears fairly static with little evidence of a new improved model, it would appear that aircraft design must bear the brunt of any innovations. Operators should cooperate with aircraft designers to achieve the best possible arrangement of instruments, lighting, heating and other flight deck details, endeavoring to eliminate unnecessary or difficult maneuvers during flight. The simpler the task the less fatiguing its performance. As visual requirements are so important especially in this era of rapid closure and density of traffic, aircraft designers should endeavor to provide the best possible visibility together with such instrument grouping as might best lessen the visual strain upon the aircrew. Studies of transport pilot behavior on routine flights has provided data on the best layout for controls. With existing systems it has been shown that many of the controls are as much as 15 inches beyond average finger tip reach with the result that their manipulation requires considerable trunk movement causing bodily and visual displacement from the usual flight position. It was also pointed out in these studies that the working area of a single arm or hand is a semicircular rather than a straight flat area so that an arrangement of the control panel on a curve would be a considerable improvement.

Proper Coding

Since the possibility of human error during fatigue, emotion or physiological stress is ever present it is suggested that proper coding of controls by variations in position, shape, color and size might reduce the likelihood of such error. Operators already recognize the benefits of good ground services with detailed meteorological briefings. This, together with available aids to navigation and landing, does much to alleviate anxiety and thus prevent fatigue. All these factors can help to prevent the incidence of fatigue and together with frequent rest periods for recuperation can do much to avert cumulative fatigue and aeroneurosis. It is pointed out in passing, that a number of airlines are introducing airborne weather radar in their aircraft which enable the crews to identify and avoid areas of turbulence, lessening strain upon themselves and the aircraft and avoiding disruption of schedules.

Global Regulations

Organizations such as the International Civil Aviation Organization, the International Air Transport Association and the International Labor Organization as well as many pilot organizations are all intensely interested in the problem and are endeavoring through their members to arrive at a satisfactory solution. As already noted studies have produced so many variables that it is unrealistic to attempt to provide international regulations to cover all exigencies and there appears to be a considerable difference of opinion as to the right method of resolving the difficulties.

Lack of quantitative units to measure fatigue has been a major stumbling block but there appears to be substantial measure of uniformity among States as to the ultimate limits of flight crew endurance, which has resulted in the imposition of flight time limitations in many countries. There are, however, many who disagree that international standards are necessary or even desirable and who think that each State or operator is best left to make its own decisions and bear its own responsibilities.

ICAO Studies

The International Civil Aviation Organization, studied the matter of flight fatigue at its First and Second Operations Division meetings in 1946 and 1947, and recommended the adoption of flight time limitations covering periods of one day, one week, one month and one year. Although ICAO published these as Recommended Standard Practices and Procedures as early as 1946, later, in 1947, it was decided that they were not mature enough nor practicable for world-wide application. In their place a general standard placing the responsibility on the operator through States was adopted as follows:

"An operator shall establish limitations on the flight time of flight crew members. These limitations shall be such as to ensure that fatigue, either occurring in a flight or successive flights or accumulating over a period of time, does not endanger the safety of a flight. The limitations shall be approved by the State of Registry."

Subsequent ICAO operations meetings have again discussed the problem of flight time limitations, but it has not

(Continued on Page 12)

OBLIGATION

Down through the eons of time, mankind has brought with him an obligation second only to the Deity. That obligation to a fellow man sometimes comes to us disguised in the cloak of responsibility.

To an even greater degree than in other professions that responsibility reposes directly on you.

You, in your decisions, decide the margin from the fate. Your fellow man, through some sixth sense is aware of your obligation. On the strength of that obligation alone, he places in you and in your ability a blind confidence, a complete trust. As a monument to that confidence and trust, in your hands he places his life. What greater testimonial could he offer? May God in his infinite wisdom always guide you in your decisions. May you in the making of decisions, never violate the confidence of your fellow man.

J. L. TOMPKINS
E.A.L. No. 60

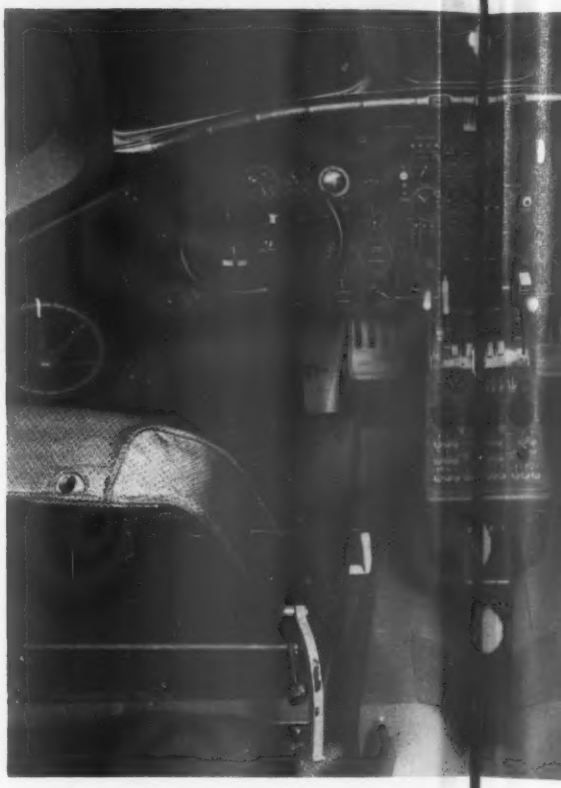
The ALPA C

Instrument Rating At 17

L. J. Mercure, supervising agent, General Safety District Office, CAA, is shown as he grants 17-year old Gary Wright, East Point, Ga., his instrument rating, probably the youngest pilot to have such a rating, as Gary's father, DAL Capt. K. D. Wright, who taught him to fly, looks on.

DC-8 Cockpit

Pilot and co-pilot stations in mockup of DC-8 cockpit, as revealed in recent Douglas photo.

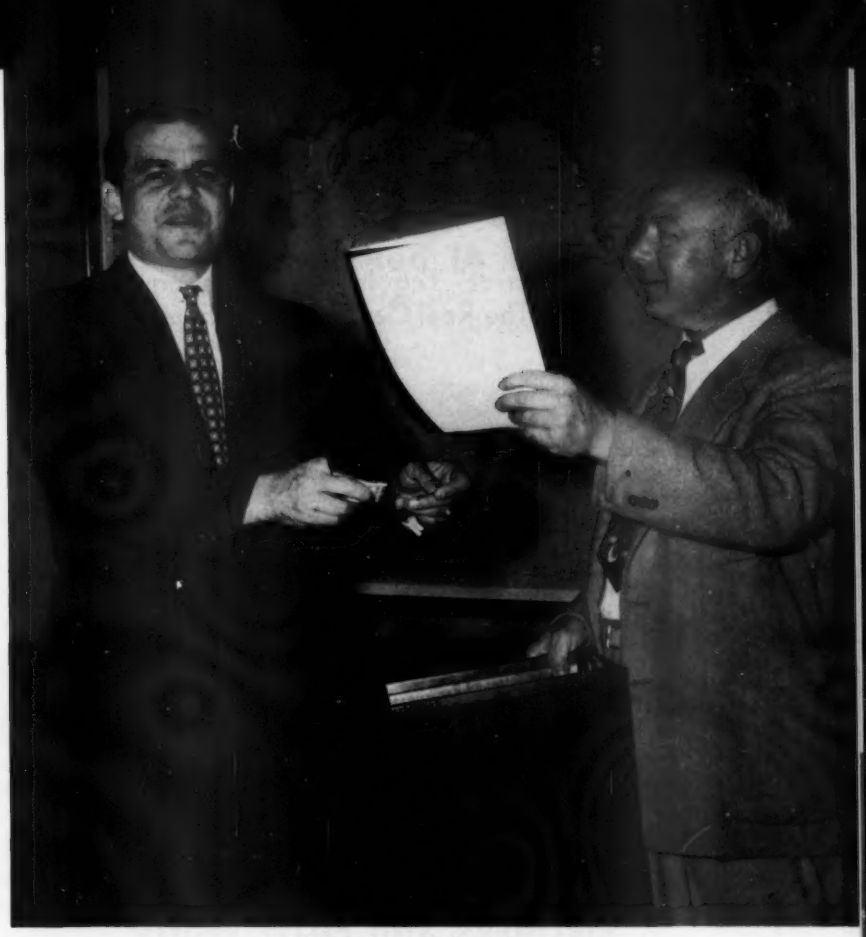


Quarter-Century Pilots

UAL pilots, who have flown 25 years for company, were honored by airline at recent banquet in San Francisco. Shown (from left): UAL President W. A. Patterson; Capts. R. F. Dawson, E. B. Gray, C. J. Dunbar, R. B. Andrews, J. W. Belding, J. A. Smith, R. P. Fregulia; I. E. Sommermeyer, director of flying; Capt. R. P. Craine, D. R. Petty, v.-p., flight operations; W. D. Williams, manager, flight operations, SFO, and (foreground) Capt. L. R. Schram.

PA Camera

C-8 Cockpit
tions in mockup version of typical
aled in recent Douglas Aircraft Co.



ALPA Burns Mortgage

President C. N. Sayen and Treasurer D. J. Smith symbolically set match to ALPA Building Mortgage as Association completed final payment of $21,171.72, on its Home Office building, July 16. By taking advantage of pre-payment privileges, the mortgage was paid off in far less time than otherwise would have been possible, thereby saving considerable interest. The total building cost was $755,000 and a $300,000 mortgage was obtained to be paid off at $7,500 quarterly. Since 1953, ALPA has been taking advantage of a pre-payment clause permitting paying an additional $30,000 annually without penalty. The final payment to the First National Bank of Chicago included the $7,500 quarterly payment and a pre-payment of $13,671.72.

ALPA Milestone

Emil Goers, superintendent of ALPA's mail room (left), processes 500,000th piece of mail sent from Home Office since January 1, as G. R. Johns, Council Coordinator, looks on. Association now has over one million mailings a year.

A Pilot Reflects On 'Pilot Error'

The 'Pilot Error' Tag Is Self-Defeating, Says The Author, Because It Fails To Ferret Out The Real Causes Of Accidents In Order To Prevent Their Recurrence

By David W. Richwine
TWA

Insurance actuaries have indicated that because of the physical standards required by my position as an air line pilot and because of the ever improving safety record of the scheduled airlines, I stand an excellent chance of exceeding the life expectancy of the average U. S. male. Since I have a family of four children to raise and educate to the point where they can make their own way in this world and because I find life on this earth both worthwhile and rewarding, I intend to do everything in my power to insure that these actuaries are right.

While I am not afraid of death itself, there is one fear that plagues me, flaring periodically when there is a fatal airline accident. I refer to the specter of having my family and friends faced with screaming headlines assessing me the full blame for an aircraft accident, in the event I should ever be unfortunate enough to be involved in one.

Cites Safety Efforts

Like most other air line pilots, I have devoted the major portion of my productive earning career to aviation. I think it is a wonderful, dynamic, challenging and, certainly useful, industry. I am proud to be a part of it and hope to continue in it for many years to come. In my more than twenty years as a pilot, I have not only put in thousands of hours in the cockpit, but have tried to do my part in furthering air safety. I have combed through airplane wreckage strewn over unbelievably wide areas, hauled bodies of my friends from the water, and have even salvaged parts which might give a clue to the cause of an accident from the bottom of the sea. I have evaluated accident and trouble reports for the Navy, and taken part in many CAA, CAB, and company hearings held as a result of airplane mishaps. All of this has been done in an effort to help determine causes of accidents and seek ways of preventing them in the future.

Just as many gallant Americans have died for the cause of their country's freedom, so have many gallant airmen, including a long list of my personal friends, for the sake of an industry they loved and to which they devoted their lives. I have read with meticulous care the voluminous CAB accident reports purporting to set forth the causes of our aviation disasters, and confess I suffer a sickening feeling at reading the all too frequent conclusion that the pilot alone was in error. Further, I have seen examples wherein a pilot has been castigated by inaccurate statements based on highly speculative, fragmentary and inconclusive evidence. These allegations are issued presumably for their newsworthy value without regard for the man's contribution to the industry to which he has given his life, or, the welfare of his family, friends, and the company for which he worked. The latest example of this appeared in a news story on Saturday, July 7. In this article, Captain Jack S. Gandy, a TWA pilot with a spotless record of over twenty years as a pilot, was assessed full responsibility for the mid-air collision of two large scheduled airliners over the Grand Canyon a week before, by a CAB air safety "expert." Thanks to the courage and sense of moral responsibility of other government officials and conscientious newsmen, several subsequent articles appeared, which tend to ease this stigma. However, there still remains some irreparable damage.

AIRLINERS AND PILOT VISION

From an editorial in
THE ST. LOUIS POST-DISPATCH

When William K. Andrews, director of the Civil Aeronautics Board safety investigation division, told a House subcommittee investigating the collision of two airliners over Arizona that "TWA had full responsibility for maintaining separation" from other air traffic, he certainly did not go out of his way to give the Congressmen the full picture of the situation.

He might also have pointed out that the modern commercial airliner gives the pilot little more view than is absolutely necessary to take a plane off and land it—a matter definitely in the jurisdiction of the safety division. It is impossible in present cockpits for the pilot to see to the rear, above or below his plane. Only by moving his face close to the windshield can he see more than a thin ribbon of sky either forward or to the sides. Even then vision in these directions is sharply limited.

How, then, could the pilot of the Super Constellation see the faster DC-7 overtaking him from the rear if that is what happened? And, for that matter, unless the two planes were at almost exactly the same altitude and on the same course for some time, how could the pilot of the DC-7 reasonably be expected to see the other plane?

It is too early to toss the matter off as probably the result of pilot error. There is no question that it is the primary responsibility of the pilots to prevent collisions if weather conditions permit them to see other planes, regardless of what type flight plan they are operating on. And it might be noted that they are betting their own lives on their vigilance, as well as those of their passengers.

But the overriding responsibility for air safety is on the Government agencies. They ought to help pilots by notifying all planes, as a matter of course, of other air traffic in their immediate vicinity. This ought to be the case whether or not there is a change in flight plans since schedules may be altered without a formal change in flight plans.

As for visibility, it is long since past time for the Government to stop certificating airliners with vision so restricted that it would not be countenanced in automobiles.

Why Blame Pilot?

I have searched diligently for some true justification of this long standing and nefarious practice of blaming the pilot alone for these aerial disasters. The determination by almost everyone involved to avoid responsibility seems to stem from a fear of economic loss or political jeopardy, both of which are highly unjustifiable. That the pilot is an easy target for blame, due to the fact he is the last one in position to take preventive action, would hardly justify such moral dereliction in an otherwise proud and honorable industry.

I do not hold that pilots are blameless in aviation accidents. They, like other humans, do make mistakes. I do hold that there are contributing factors which often weigh more heavily than the pilot's part in the overall analysis, and which are rarely brought to the attention of the general public. These reasons why pilots err often start on the designing board where the plane is designed, and are found in many places along the line clear up through the governmental regulatory agencies and into Congress, who must allocate the funds which limit the functions of these groups. They include poor cockpit visibility, which is borne out by the fact that most mid-air collisions and near misses occur under conditions of good weather; inherently weak component systems in new aircraft, that are only brought out after many hours of actual operating experience; inadequate operating procedures and regulations; and *a woefully outmoded system of air traffic control.*

I have come to expect to see "pilot error" tabbed on most official accident reports. It seems to be a routine answer. I am, however, hoping for the day when I see just as clearly in print the reasons why a pilot with so many years of operating experience, and with such a high degree of repeatedly demonstrated professional skill, made his fatal error, if he really did. I am also waiting for the day when the "experts", who investigate and formulate final conclusions regarding the causes of aircraft accidents, openly admit to the public that the human eye and pilot's reaction time alone are not enough to avoid mid-air collisions, and that a pilot cannot always be expected to make in a few split seconds, under conditions of compound difficulties, the same sage decision they, as a group, often come up with after months of painstaking study and analysis of all factors leading up to an accident.

All Make Mistakes

An industry is made up of people, and all people who accomplish anything make mistakes. Some of these are minor and inconsequential; some are catastrophic in their consequences. It is not my purpose to put the blame for aviation accidents on any one person or group within the industry. Aviation safety is the joint responsibility of the various manufacturers, operators, pilots, and governmental agencies and should be treated as such, rather than continuing to try and point the finger at someone in particular. No one who has done his best should be afraid to admit an honest error. The only unforgiveable thing would be to fail to learn something constructive from such mistakes.

The aviation industry has come a long way through the joint efforts of

That These Dead Shall Not Have Died In Vain

By Paul Harvey

ABC *News Analyst and* General Features *Columnist*

There is only one instance in the United States where we convict a man for a crime without a trial.

Though he is unable to testify in his own behalf, we charge him with what amounts to manslaughter—then find him guilty. There can be no appeal.

This happens when we investigate an air crash and on the flimsiest evidence announce that it was due to "pilot error."

That explanation is sometimes correct, always convenient.

I am thinking now about the recent mishap over the Grand Canyon. That these 128 shall not have died in vain, something is going to be done about broadening the skyways.

We will modernize, improve, perfect as nearly as possible the handling of the increasing air traffic.

But there is further improvement needed.

A spokesman for the Air Line Pilots says there is no evidence whatever that either pilot was even a little bit to blame.

'Pilot Error' Tag

Yet if the investigators follow their customary procedure in this case, "pilot error" is the explanation that will go down in the record.

Nobody can possibly sort the fragments of one of these big tin monsters and know with any degree of certainty whether there was a structural failure before—or after—the crash.

Only very rarely is there any evidence that a court of law would admit.

Yet with callous disregard for the reputation of the pilot . . . a reputation his survivors must live and die with . . . the accident analysts will sift through this junk and, in the absence of any proof that the pilot was innocent they will brand him guilty!

Against American Principles

That's backward from established American principles of jurisprudence.

The dead pilot is guilty because they can't find evidence to exonerate him!

"Pilot error" they say.

With the blood of his dead passengers on his hands why don't they just charge the dead pilot with "manslaughter due to criminal negligence." It amounts to the same thing.

And he can't denv it, can't appeal it.

I am gratified to see the Congressmen on the scene agree that our air traffic control system, unchanged for twelve years, was outgrown ten years ago.

Even the CAA is ready to admit there'll have to be some changes made. "The regulations need overhauling."

But while we analyze and institute improvements in directing the increasing flow of airway traffic . . .

Let's also eliminate the un-American practice of attributing every accident we can't otherwise explain to "pilot error."

Guessing Aloud

The coroner, in any other instance, would never "guess aloud."

In any other fatality where the evidence is as dubious and controvertible as it is in most air crashes, the coroner would say death was "due to unknown causes."

Where there is no conclusive evidence to the contrary, we owe the pilots who cannot speak for themselves at least comparable consideration.

all of those who are a part of it. The public has been courageous, patient and generous in supporting its development. Today we rarely see a marked decline in air travel following a major air disaster such as was common only a few years ago. There is little to be feared from public reaction as long as the public knows that we are working toward the common objective of an even safer and more reliable aviation industry. This can certainly be achieved without over-emphasizing or distorting the pilot's part in aviation accidents or using him to cover up other weaknesses in our system.

House Report On Drinking Bill

Text Of Report Of House Interstate & Foreign Commerce Committee On H.R. 8000

(EDITOR'S NOTE: *H.R. 8000, a bill to prohibit serving alcoholic beverages aboard aircraft is expected to be taken up by the House of Representatives before adjournment. Here is the Committee report on the reasons and background of the proposed legislation.*)

"The purpose of this bill is to prohibit the selling or serving of alcoholic beverages by domestic air carriers to passengers while in flight between points within the limits of the 48 States and the District of Columbia.

"The committee urges favorable action on this legislation to eliminate a potential hazard in the operation of domestic air carrier aircraft.

"Ways of meeting this potential hazard have been discussed at length in the industry but no solution has been reached. Despite the growing awareness that this is a problem, the number of flights on which alcoholic drinks are being served continues to increase and voluntary industry-sponsored control now seems unlikely. Thus, it would appear that legislation is necessary.

"In that connection, it should be pointed out that only a few of the domestic airlines now serve alcoholic drinks to passengers. Without legislation, carriers who thus far have resisted the trend may be forced by the competitive situation to begin serving alcoholic drinks.

"H.R. 8000 was introduced as a result of appeals made by the Air Line Pilots Association and the Air Line Stewards and Stewardesses Association after efforts to get relief by regulation or agreement within the industry failed. The two associations amply documented the need for legislative action in testimony before the Subcommittee on Transportation and Communications. Witnesses cited numerous instances of hazards to safety and unnecessary annoyances to other passengers resulting from excessive drinking by passengers.

"In addition to eliminating the potential safety hazard, Congress has an obligation to protect passengers in interstate commerce from annoyances and inconveniences such as cited by witnesses.

Problems Cited

"The serving of intoxicating liquor by the airlines results in these three problems:

"1. The unregulated consumption of liquor by airline passengers is a compromise with safety. There is always the danger that a passenger who has overindulged can interfere with the crew.

"2. The serving of liquor to airline passengers places an unnecessary burden on flight crews. The operation of large, modern transport aircraft requires the constant and diligent attention of flight crews. Crew members have more important tasks than policing unruly passengers. The pilot in command must assume the responsibility for the orderly conduct of passengers. Instances were cited where the pilot was forced to subdue unruly passengers. Had serious injury to the pilot or any crew member resulted, the flight would have been deprived of that person's service, thus creating a potential emergency situation.

"3. Drinking on passenger aircraft creates a social problem, in that even though no safety hazard develops, the passenger who overindulges may offend or annoy other passengers. Drinking cannot be confined to club cars, as on trains.

"No claim is made that the entire problem faced by the airlines in this area can be solved by legislation. Self-regulation is necessary and will become increasingly important.

"H.R. 8000 covers only the serving of alcoholic beverages in domestic flights within the 48 States and the District of Columbia. Any effort to extend the legislation to cover international flights would complicate an intense competition for traffic in which United States flag carriers are involved with foreign airlines.

"A problem is caused by passengers who bring their own liquor on board and by the passenger who has had too much to drink before boarding the airplane.

"Enactment of H.R. 8000 will assist the carriers in meeting this problem. The Civil Air Regulations (sec. 43.45) now provide that

> 'a pilot shall not permit any person to be carried in the aircraft who is obviously under the influence of intoxicating liquor or drugs, except a medical patient under proper care or in case of an emergency.'

"The committee was told that before the airlines began serving liquor, passengers under the influence of alcohol were not permitted to board a plane but that now, as might be expected, enforcement has been relaxed on those flights where liquor is served. A pilot in command would naturally find it difficult to ask a passenger who has been drinking not to board a plane on which drinks are to be served.

"Testimony was that since the airlines started serving drinks the number of passengers bringing their own liquor aboard has increased sharply. Here, again, the problem of control has been complicated by the serving of liquor by the airlines. Enactment of H.R. 8000 will make it easier for the pilot in command to control the situation."

Fatigue . . .

(Continued from Page 7)

been possible to formulate more detailed standards in this respect and the general standard quoted above is effective today.

The objective of a limitation of flight time is to prevent such degrees of fatigue of crew members as to interfere with flying safety. In general, existing State regulations specify the maximum periods of time during which flight personnel may be exposed to conditions most likely to induce fatigue. These periods are variously expressed in terms of hours of duty, or hours of flight time and are generally supplemented by cor-

responding requirements for periods of rest. Regulations apply variously to the complete crew, the flight crew only, the pilots separately, other members of the flight crew separately and non-technical members of the crew. In spite of the variations between the provisions of existing regulations it appears that there is a large measure of agreement that the danger arising out of flight crew fatigue can be substantially alleviated by the imposition of flight time limitations.

Economical Facts

Unfortunately this type of regulation, while halcyon in concept, fails to take into account certain economical truisms. In order to follow these regulations it is often necessary for the operator to station slip crews in inaccessible and frequently unhealthy spots or to provide two or even three crews to an aircraft. The scheduling of aircrew on long international flights exceeding flight time limitations makes it necessary for crews to lay over at a foreign base while a relief crew takes over the aircraft. This tends to make operations overly expensive and leads to curtailed services, increases in fares and freight charges or cuts in salaries to crews.

Many crews would prefer to exceed the flight time limitation by several hours in order to complete their flight at an airport with reasonable rest and recreation facilities than adhere to the letter of the law and trans-ship at some small airport where facilities for rest may be practically non-existent. Crews are notoriously unprepared to spend any extra time away from their home bases and discontent arises when existing regulations necessitate their doing so.

The problem may perhaps be overcome by providing extra crew but this is often limited by the design of the aircraft when no further crew space is available. Rest facilities might be provided aboard the aircraft for the crew after their elapsed time of duty but this again poses a design problem as adequate facilities cannot always be provided as pointed out in a recent accident report, which reads in part: "A mattress is provided which is placed over the luggage in No. 3 Hold." In any case, it is doubtful whether adequate rest could be obtained on board, for the Captain at least, since if weather or other conditions present any difficulty he would doubtless wish to be at the controls. Faster cruising speeds of aircraft now in the design stage may have an effect on crew scheduling since this speed might prevent the exceeding of flight time limitations on many routes now in excess of such limitations.

There has been a mistaken concept in many quarters that the only answer to aircrew fatigue is to lessen exposure time by flight time limitations and a great deal of the attention of experts has been diverted into this area. Actually, the limitation of flight time and corresponding "on duty time" is only one of the many methods that can be employed to reduce fatigue. The whole aviation industry and its associations have been working, under the highest pressure, to improve safety, regularity and efficiency of air navigation, which in effect reduces the load on the aircrew and goes a long way toward reducing fatigue.

During the last decade improvements in navigational aids, aircraft performance, automatic pilots, improved instrumentation, pressure cabins with air conditioned working quarters, better facilities on the ground for the crew, better meteorological forecasting and communications, among others, have reduced anxiety and relieved tension for crews.

In effect many of the variables influencing fatigue have already been removed or greatly alleviated by international bodies in providing world-wide uniformity of equipment and aids and by the efforts of designers. The technical standards and recommended practices adopted by Member States of ICAO in the fields of communications, meteorology, rules of the air, operations, airworthiness, airports, visual aids, licensing and training, have all helped to remove difficulties and lessen anxiety by providing basically the same air and ground facilities and procedures wherever the aircraft is flying.

Labor Groups Study Problem

The International Labor Organization and the International Transport Worker's Federation, have been considering this problem and are actively engaged in studying flight crew fatigue mainly from the social standpoint. Both of these organizations have been working in very close co-operation with ICAO on this matter, and are at present studying the various regulations governing duty time and flight time limitation with a view to world standardization of duty time and the betterment of working conditions. The ILO is studying the social problems at a meeting to be held later this year, when conditions of employment in civil aviation, hours of work of flight personnel and income security of flight personnel after retirement or grounding will be discussed.

The International Air Transport Association, the International Federation of Air Line Pilots Associations, and many other similar organizations on the

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national level are also vitally interested and have studied the problems and made recommendations.

From the foregoing it will be obvious that the problem of fatigue has received a great deal of consideration and nations, principalities and powers, not to mention pilots and operators, have all contributed towards a solution. It is hoped that this article will help all concerned to appreciate each other's difficulties and even, perhaps, convert those who feel that fatigue is an illusion rather than a problem, in order that an even greater cooperation may result among them.

A Case In Point

The findings of the United States Civil Aeronautics Board in the case of the accident to the European airliner provide several interesting and pertinent pointers on fatigue in aircrew and it is proposed, in conclusion, to allow these facts to speak for themselves. It should be noted that this aircraft carried a large crew complement, a Captain who had made 150 Atlantic flights, 75 into Idlewild Airport, three other pilots, a radio operator and two flight engineers as well as cabin staff. It would be reasonably assumed, therefore, that excessive duties were not undertaken by any individual. However, as the Civil Aeronautics Board report states:

"Company officials testified that on a normal North Atlantic flight the Captain and one of the other pilots would fly the aircraft to Shannon and then would rest during the Atlantic crossing while the other pilots flew the aircraft. After reaching the more congested areas of the United States the Captain again would take control until the flight terminated. This procedure afforded each pilot nearly equal rest periods. The bunks on board the aircraft provided them with the best rest possible considering it would be under flight conditions and with continuing respective responsibilities for the flight . . ."

". . . There is no reason to believe that normal rest procedures were not followed. It is nevertheless believed fatigue was a factor in this accident. It was not only present as a result of the time en route, approximately 22½ hours, but mostly a result of the additional extended 2½ hours period devoted to the four approaches and the high mental and physical demands made upon the pilots. The element of fatigue is strongly suggested especially during the last approach. Fatigue is evidenced by the pilot's poor adherence to the localizer path, the last descent to a very low altitude before the sharp pull-up, and the evidence of abrupt control action. It may also be noted to some degree in the pilot's slow response to the wind shift and the probable loss of airspeed which caused the sinking descent before the aircraft struck the pier. These factors lend credence to the belief that the pilot's efficiency and normal ability were seriously impaired by fatigue."

(*From* THE JOURNAL OF THE ROYAL AERONAUTICAL SOCIETY, *March, 1956*)

Common System . . .

(Continued from Page 4)

ance of conflicting or dangerous clearances. Equally ingenious and part of the communications system, is a storage system which derandomizes his instructions, and through a scanning device calls the appropriate aircraft and delivers the clearance. This clearance is voice or digital, whichever is appropriate. The voice may be canned, and even speeded up in transmission. It

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should be remembered that position data except probably altitude and associated identification can be derived from the radar. Initially, a clerk or clerks will associate the radar echoes with the appropriate identification, but this will gradually be done by digital computation. The digital computer can use the same rules for their association as the clerk can. Our problem is to find out the minimum logical process that the clerk goes through and program it into the computer.

Finally, the comparison between clearance and position will be done automatically, and the controller will be by-passed. This will not be a difficult concept to swallow, if it is remembered that a machine will be used to prevent human error initially. The rest is a simple process which can be made more reliable than a human. This may never require less controllers since the system will work 24 hours a day, and will require three-shift operation.

Depends On Global Condition

It should be clear that this system based on radar coverage wherever necessary, is a product of the international political situation. If, in the future, there is sufficient lessening of political tension to eliminate the necessity for a vast radar network, a simple digital air-ground link may be necessary whose output goes through the same communication network into the same digital computers which were used with the radar.

For navigation, today we are straitjacketed to a R-O system, which, according to our latest studies is reaching a point of diminishing returns in use of spectrum, cost, and complexity. Our first improvement will probably come through the elimination of 4-course ranges. The VOR, DME, or TACAN will gradually give way to a non-line-of-sight system. A non-line-of-sight system presumably would have a better chance, both technically and economically, of actually being a common navigation system in the sense that it would be suitable for helicopters, high flying, high speed aircraft, and for low speed aircraft. The non-line-of-sight system may be a scanning system such as the French RADIO-WEB. This will probably never be replaced if our air defense radar system drops out of the picture. If radar stays in, the ultimate navigation system will be a radar calibrated, short term stability self-contained system.

New Applications

Landing and takeoff navigation now done by GCA and ILS, will gradually be eliminated because the navigation system will be accurate enough for low approaches. Automatic landing, technically on the verge of being a reality, may never be used in the common system except by military aircraft.

In conclusion, I admit that it takes a certain amount of presumptuousness to predict such advance in the face of the slow progress we have seen in the last decade. I do not pretend that the only problem is that of devising clever methods with which to transition into more modern techniques.

Actually, the corrollary problems are more difficult. Our government organizations need streamlining and we do not have adequate test facilities for the common system. But, with a reorganized ANDB, a revitalized CAA, and the growing necessity for solution of these problems, I feel that the personnel engaged in research and development for the common system will be permitted to solve the scientific problems and that the operating organizations will use our system as quickly as we can devise it.

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He was trudging cross-country *on foot.* And conscientiously wiring in daily progress reports well-calculated to give his superiors apoplexy. His sixth, from Albany, N.Y., read in part:

> *"Entered Albany barefooted X Comfortable X Earning my keep as bartender X Local rum far superior that served in Navy X Am sending sample"*

At this, the Navy struck its colors, reversed its time-honored tradition, and began prepaying travel allowances.

Strangely enough, Joe Fyffe actually wound up as a rear admiral. That, of course, was years later; and he has long since passed to his reward. But his vigorous and outspoken independence is still alive and kicking in today's Americans. That's why our country is a strong, vital nation and why our country's Savings Bonds are one of the finest investments in the world.

165 million Americans stand behind U.S. Savings Bonds. *There is no better guarantee.* So buy Bonds regularly—and keep the ones you buy.

★ ★ ★

It's actually easy to save—when you buy Series E Savings Bonds through the Payroll Savings Plan. Once you've signed up at your pay office, your saving is done *for you.* The Bonds you receive pay good interest—3% a year, compounded half-yearly when held to maturity. And the longer you hold them, the better your return. Even after maturity, they go on earning 10 years more. So hold on to your Bonds! Join Payroll Savings today—or buy Bonds where you bank.

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